Synopsis

In the last few decades India has advanced socioeconomically due to the rapid growth of industries and automobile sector. This in turn increases the use of fossil fuel and diesel. The atmosphere gets polluted due to the harmful substances, which comes from the burning of fuel. These pollutants can be in the form of gaseous, liquid or solid particulate. Diesel engines, the major source of power in industries and automobiles, play a significant part in causing air pollution. The major pollutants in diesel exhaust are oxides of nitrogen (NO_X), sulphur dioxide (SO_2), carbon monoxide (CO), hydrocarbons (HC), particulate matter (PM), volatile organic compounds (VOC), aldehydes and alcohols. Due to the heavy consumption of diesel as a fuel there is an urgent need to control diesel exhaust.

Diesel exhaust is a complex mixture of several gases and fine particles (commonly known as soot) that contains more than 40 toxic air contaminants. Amongst the gaseous pollutants in diesel exhaust, the major concern and a challenging task is to control oxides of nitrogen, commonly referred to as NO_X as it is the major contributor for acid rain, photochemical smog etc. Successful control of emissions from diesel engines is yet to be achieved. The conventional techniques which are available to control emission now are either difficult to operate or does not satisfy the stringent emission standards. This has made the researchers throughout the world to find an alternative and effective non-conventional aftertreatment technique to reduce diesel engine emission. The failure of conventional techniques lead to the development of non-conventional techniques such as high voltage electric discharge based plasma which has already been proved to be economical and highly efficient in industrial electrostatic precipitators.

Electric discharge plasma or non-thermal plasma produce energetic electrons which react with background molecules in flue gas leading to active species such as radicals. These radicals being chemically active selectively react with the harmful pollutants facilitating their removal/reduction.

The present thesis work is an attempt to provide a technical solution to achieve higher removal efficiencies of oxides of nitrogen in the backdrop of shortcomings that exist in conventional technologies to do so. The current thesis describes the research in four stages: (i) studies on NO_X removal from diesel exhaust by cross-flow DBD reactor, where design and fabrication of cross-flow DBD reactor, exhaust treatment using cross-flow DBD reactor and exhaust treatment with cascaded plasma-adsorbent

technique is described (ii) studies on NO_X removal from diesel exhaust by compact discharge plasma sources, where design and fabrication of high frequency high voltage AC (HVAC) using old television flyback transformer, Design and fabrication of high voltage pulse (HVPulse) using automobile ignition coil, exhaust treatment with both HVPulse and HVAC and exhaust treatment with cascaded plasma-adsorbent technique is described (iii) studies on NO_X removal from diesel exhaust using solar powered discharge plasma source is described (iv) studies on the NO_X removal from diesel exhaust using red mud, where exhaust treatment with red mud and Exhaust treatment cascaded plasma-red mud is covered. The results have been discussed in light of enhancing the NO_X removal efficiency for stationary and automobile engine exhausts.

* * *